PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P100286	**FOR FURTHER ACTION**	See Form PCT/IPEA/416
International application No. **PCT**/SG2004/000075	International filing date *(day/month/year)* 31 March 2004	Priority date *(day/month/year)* 31 March 2004

International Patent Classification (IPC) or national classification and IPC

Int. Cl. ***G01N 15/08*** (2006.01) ***G01N 27/12*** (2006.01) ***G01N 33/44*** (2006.01)

Applicant

AGENCY FOR SCIENCE, TECHNOLOGY AND RESEARCH *et al.*

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 4 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. [X] *(sent to the applicant and to the International Bureau)* a total of **6** sheets, as follows:
      - [ ] sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      - [ ] sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.

   b. [ ] *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or table related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).
4. This report contains indications relating to the following items:

[X]	Box No. I	Basis of the report
[ ]	Box No. II	Priority
[ ]	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
[ ]	Box No. IV	Lack of unity of invention
[X]	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
[ ]	Box No. VI	Certain documents cited
[ ]	Box No. VII	Certain defects in the international application
[ ]	Box No. VIII	Certain observations on the international application

Date of submission of the demand	Date of completion of this report
24 January 2006	07 February 2006
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer **NORMAN BLOM** Telephone No. (02) 6283

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/SG2004/000075

Box No. I Basis of the report

1. With regard to the **language,** this report is based on:

[X] The international application in the language in which it was filed

[ ] A translation of the international application into , which is the language of a translation furnished for the purposes of:

[ ] international search (under Rules 12.3(a) and 23.1 (b))

[ ] publication of the international application (under Rule 12.4(a))

[ ] international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

[ ] the international application as originally filed/furnished

[X] the description:

pages **1-43** as originally filed/furnished
pages* received by this Authority on with the letter of
pages* received by this Authority on with the letter of

[X] the claims:

pages as originally filed/furnished
pages* as amended (together with any statement) under Article 19
pages* **44-49** received by this Authority on **24 January 2006** with the letter of **24 January 2004**
pages* received by this Authority on with the letter of

[X] the drawings:

pages **1/9-9/9** as originally filed/furnished
pages* received by this Authority on with the letter of
pages* received by this Authority on with the letter of

[ ] a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.

3. [ ] The amendments have resulted in the cancellation of:

[ ] the description, pages
[ ] the claims, Nos.
[ ] the drawings, sheets/figs
[ ] the sequence listing *(specify)*:
[ ] any table(s) related to the sequence listing *(specify)*:

4. [ ] This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

[ ] the description, pages
[ ] the claims, Nos.
[ ] the drawings, sheets/figs
[ ] the sequence listing *(specify)*:
[ ] any table(s) related to the sequence listing *(specify)*:

* *If item 4 applies, some or all of those sheets may be marked "superseded."*

Box No. V **Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims **1-39**	**YES**
	Claims **none**	**NO**
Inventive step (IS)	Claims **1-39**	**YES**
	Claims **none**	**NO**
Industrial applicability (IA)	Claims **1-39**	**YES**
	Claims **none**	**NO**

2. Citations and explanations (Rule 70.7)

The following documents cited in the International Search Report have been considered for the purposes of this report

D1: DE 10208767,

D2: WO 2003/060485,

D3: JP 09-026403,

D4: TW 518772.

Novelty (N) and Inventive Step (IS): Claims 1-39

Claims 1-39 are considered to be novel and inventive in the light of any one, or obvious combination of two or more, of the documents D1 to D4, because none of these documents (or combinations thereof) disclosese a sensor containing all the essential features as defined in the claims. In particular, none of these documents disclose or allude to a sensor incorporating a "liner layer" interposed between the base substrate (or test material) and the sensing element.

The closest prior art is considered to be **DE 10208767** (OSRAM Opto Semiconductors GmbH), published 10 July 2003. This document discloses a sensor for measuring the oxygen or water permeability of a layer. The sensor comprises a corrosion-sensitive metal, such as calcium and/or magnesium (page 3 paragraph [0014]), which oxidises in contact with water and/or oxygen to form the corresponding metal oxide. The oxide has a high electrical resistance and acts like an insulator. This sensor may be used to measure the oxygen and water transmission rates of materials used to encapsulate organic electroluminescent displays (organic light emitting devices (OLEDs)). This document indicates a need for the oxidation of the metal to occur evenly in order for the conductance to be directly proportional to the amount of corrosive substance (see paragraph [0013]) and also highlights problems that may be encountered when pinholes and tears are present in the test material (base substrate) (see paragraph [0015]). Example 9 and paragraph [0049] of the present invention outline and demonstrate the advantages conferred by the presence of a "liner layer" interposed between the base substrate (test material) and the sensor element.

(continued)

Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**

Continuation of: Box No. V. 2. Citations and explanations

The other documents cited in the ISR are distinguished from the present invention for the following reasons:

WO 2003/060485 discloses a device and method for determining the penetration of gaseous substances through a membrane using the MOCON/Toray oxygen analyser LC-700F, which contains a solid state O_2 ion conduction (zirconium oxide) sensor, which due to oxygen vacancies in the ceramic lattice structure of the zirconium oxide material, oxygen ions are able to move in the solid material at an elevated temperature. This property enables the measurement of oxygen in a gas of unknown composition.

JP 09026403 discloses a sensor for detecting moisture in a diaper which has a reactive material, such as calcium, provided between two electrodes. The sensor functions as an electrical switch. There is no suggestion that this sensor may be used to measure gas permeability of a test material.

TW 518772 discloses a light emitting device which contains calcium, magnesium or barium. This metal is converted to the corresponding oxide by reaction of the metal with oxygen. The calcium, magnesium or barium oxide film acts as a moisture (water) absorbent for any moisture that exists in the isolation sealing layer. There is no suggestion that the calcium, magnesium or barium metal may be used to quantify the amount of oxygen or water that permeates the sealing layer.

Industrial applicability (IA): Claims 1-39

The invention defined by the claims is considered to possess industrial applicability in the oxygen and water vapour sensor manufacturing and applications fields.

WHAT IS CLAIMED IS:

1. A sensor for measuring gas permeability of a test material, comprising:

an electrically conductive sensing element that comprises a water and/or oxygen sensitive material, wherein the reaction of said material with water or oxygen when the sensing element is contacted with water and/or oxygen results in a change in the electrical conductivity of the sensing element,

two electrodes electrically connected to the sensing element,

a base substrate that supports the sensing element, and

a liner layer interdisposed between the sensing element and the base substrate.

2. The sensor of Claim 1, wherein the electrodes provide electrical connection between the sensing element and an electrical signal evaluation means.

3. The sensor of Claim 1 or 2, wherein the water and/or oxygen sensitive material is selected from the group consisting of a conductive organic polymer, metal, metal alloy, metal oxide, and mixtures and combinations thereof.

4. The sensor of Claim 3, wherein the metal is calcium or magnesium.

5. The sensor of Claim 3, wherein the conductive organic polymer is selected from the group consisting of polyaniline, polypyrrole and polythiophene, polyacetylene, poly-p-phenylene, and polyvinylpyridine, thiophene-bipyridine copolymers, polypyridine, polybipyridine, and organometallic polyphenylenes.

6. The sensor of Claim 3, wherein the metal oxide is selected from the group consisting of VO_2, CrO_2, MoO_2, $LiMn_2O_4$, Cd_2SnO_4, $CdIn_2O_4$, Zn_2SnO_4 and $ZnSnO_3$, and $Zn_2In_2O_5$.

7. The sensor of any one of Claims 1 to 6, wherein the electrodes comprise an electrically conductive material selected from the group consisting of a metal, metal oxide and mixtures and combinations thereof.

8. The sensor of Claim 7, wherein the metal is selected from the group consisting of silver, gold, aluminium and copper.

9. The sensor of Claim 7, wherein the metal oxide is selected from the group consisting of indium tin oxide, aluminium zinc oxide, and indium zinc oxide.

10. The sensor of Claim 9, wherein the base substrate comprises a polymeric material.

11. The sensor of Claim 10, wherein the polymeric material comprises an organic polymer selected from the group consisting of polycarbonate, polyethylene, polythersulfone, epoxy resins, polyethylene terephthalate, polystyrenes, polyurethanes and polyacrylates.

12. The sensor of Claim 10, wherein the polymeric material comprises an inorganic polymer selected from the group consisting of silicones, polydimethylsiloxanes, biscyclopentadienyl iron, polydichlorophosphazene and derivatives thereof.

13. The sensor of Claim 9, further comprising a barrier layer formed on the base substrate.

14. The sensor of Claim 13, wherein the barrier layer comprises a material selected from the group consisting of metals, metal oxides, ceramic oxides, inorganic polymers, organic polymers and mixtures and combinations thereof.

15. The sensor of any one of Claims 1 to 14, wherein the electrodes are located on a surface of the substrate.

16. The sensor of Claim 15, wherein the electrodes are spaced apart, thereby forming a trench.

17. The sensor of Claim 16, wherein the sensing element is located in the trench.

18. The sensor of any one of Claims 1 to 17, further comprising an encapsulation enclosing the sensing element.

19. The sensor of Claim 18, wherein the encapsulation comprises a polymeric material selected from the group consisting of epoxy polymers, polysulfide, silicone and polyurethane.

20. The sensor of Claim 19, wherein the encapsulation provides a hollow space around the sensing element.

21. The sensor of Claim 20, wherein the hollow space is filled with an inert gas.

22. The sensor of Claim 18, further comprising a cover substrate, wherein the encapsulation is formed as side (lateral) walls surrounding the sensing element, and the cover substrate is arranged to be in contact with the side (lateral) walls.

23. The sensor of Claim 22, wherein the cover substrate comprises a material selected from the group consisting of glass, aluminium and copper.

24. The sensor of any one of Claims 1 to 23, further comprising a protective layer covering at least a portion of the sensing element.

25. The sensor of Claim 24, wherein the protective layer comprises a material selected from the group consisting of a metal, a metal alloy, a metal oxide, a metal oxide mixture, a metal fluoride and an organic polymer.

26. The sensor of Claim 25, wherein the metal fluoride is selected from the group consisting of LiF and MgF_2.

27. The sensor of any one of Claims 1 to 26, wherein the liner layer comprises an organic polymer.

28. The sensor of Claim 27, wherein the organic polymer is substantially permeable to gas.

29. The sensor of Claim 27 or 28, wherein the organic polymer is selected from the group consisting of acrylic polymers, and parylene type polymers.

30. The sensor of any one of Claims 1 to 29, wherein the liner layer comprises an inorganic polymer.

31. The sensor of Claim 30, wherein the inorganic polymer comprises a silicone-based polymer.

32. A method of producing a sensor for measuring gas permeability of a test material, said method comprising:

providing a base substrate that supports a sensing element and that further comprises a liner layer,

depositing on the liner layer an electrically conducting sensing element that comprises a water and/or oxygen sensitive material so that the liner layer is interdisposed between the base substrate and the sensing element

providing two electrodes, and

connecting the electrically conductive sensing element to said pair of electrodes.

33. The method of Claim 32, wherein the electrodes are deposited on a surface of the substrate.

34. A system for measuring the gas permeability of a test material, said system comprising a sensor for detecting moisture permeation through the test material, said sensor comprising:

an electrically conductive sensing element that comprises a water and/or oxygen sensitive material, wherein the reaction of said material with water or oxygen when the sensing element is contacted with water and/or oxygen results in a change in the electrical conductivity of the sensing element, and

two electrodes electrically connected to the sensing element, wherein the electrodes provide electrical connection between the sensing element and an electrical signal evaluation means,

a base substrate that supports the sensing element, and

a liner layer interdisposed between the sensing element and the base substrate.

35. A method of determining the gas permeability of a test material using a sensor for measuring gas permeability of the test material, said sensor comprising:

an electrically conductive sensing element that comprises a water and/or oxygen sensitive material, wherein the reaction of said material with water or oxygen when the sensing element is contacted with water and/or oxygen results in a change in the electrical conductivity of the sensing element, and

two electrodes electrically connected to the sensing element, wherein the electrodes provide electrical connection between the sensing element and an electrical signal evaluation means,

a base substrate that supports the sensing element, and

a liner layer interdisposed between the sensing element and the base substrate

wherein said method comprises:

i. contacting the sensing element with water and/or oxygen;
ii. measuring the changes in electrical conductivity of the sensing element over a period of time; and
iii. calculating the gas permeability coefficient of the test material based on the measurements.

36. The method of Claim 35, further comprising measuring the change in 1/f type noise spectrum density over the period of time.